HOW GASES ENTER INSECTS.

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INTRODUCTION.

Few experiments have been performed to show how insects take in various gases, whether the gas enters through the spiracles alone, through other openings in the chitin, or even through the chitin. Schafer* has performed a few experiments in which he placed insects in the gas hydrogen sulphide until nearly dead, when they were removed and a warm solution of lead acetate was injected into their bodies by means of a fine hypodermic needle. A black precipitate of lead sulphide showed where the gas had penetrated. In these experiments only larger insects such as white grubs could be successfully used.

Chitin as a rule is rather an impermeable substance and the results in the larger insects showed that the gas had entered through the spiracles. The question arises, Do the smaller insects such as mealy bugs, white fly, soft scales, etc., which have a much thinner layer of chitin depend alone upon their spiracles for the penetration of gases into their bodies? After trying several different agents, it was found that osmic acid vapor could be used as a gas on the insects and would darken the tissues where it entered the insect.

METHOD.

The insect to be studied was placed in a small vial in its natural position on the leaf or stem and the vial suspended in a large bottle containing crystals of osmic acid. The bottle was then stoppered and placed under a bell-jar to prevent a leakage of the gas into the room. The insects remained in the gas for various periods of time, depending upon the insects, after which they were removed, placed in alcohol, and through xylene, finally being mounted in balsam for study.

*Michigan Agricultural Experiment Station, Technical Bulletin, No. 11, July, 1911, pp. 16.

RESULTS.

White grubs or the larvæ of wood-borers, showed a blackened area about the spiracles only. Too long an exposure to the vapor causes a uniform blackening of the chitin. Mealy bugs exposed for two to four hours showed a black area around each spiracle, and in addition a black area around the anus, extending up the alimentary canal. The anal lobes which contain many wax glands were also blackened, showing that the gas had entered the wax pores. The wax of the mealy bug was not blackened by the treatment. This is of particular interest, as the mealy bug contains only two pairs of spiracles located near the anterior end of the body. Contrasted with the mealy bug, one finds that the immature stages of the white fly, which is well-protected by a wax coat, only shows a penetration of the gas through the spiracles. The white fly has four pairs of spiracles evenly distributed, one pair being located near the anus.

Spraying plants infested with mealy bugs with a weak soap solution to remove the wax greatly increases the ease with which these insects can be killed by hydrocyanic gas fumigation, while little effect is noticed in its efficiency for white fly.

A species of soft scale, Coccus sp., showed penetration through the spiracles, the anus and also the wax glands scattered about the body. Aphids show the spiracles marked, while some osmic acid seems to enter at the nectaries.

CONCLUSION.

These few experiments show that gases can penetrate through other parts of the body than the spiracles. It seems, however, that very thin chitin is impermeable to osmic acid. Even the vapor of osmic acid, however, is not a good penetrating agent. Oxygen and probably other gases, particularly hydrocyanic acid, which is extremely soluble in water has greater penetration and may even penetrate through thin layers of chitin.